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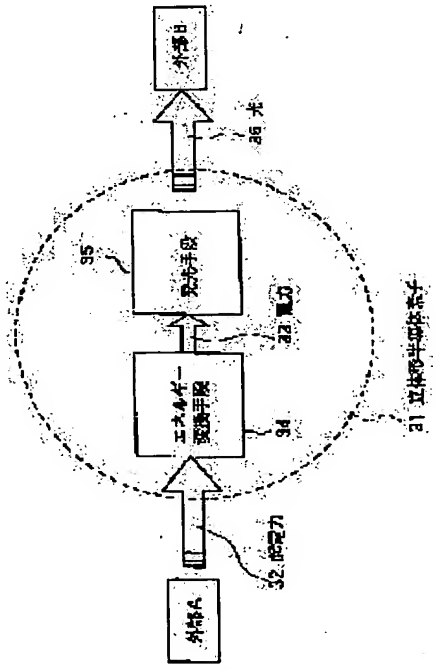
(71)Applicant : CANON INC
(72)Inventor : INOUE RYOJI
KUBOTA MASAHIKO
IMANAKA YOSHIYUKI
MOCHIZUKI MUGA
ISHINAGA HIROYUKI
SAITO ICHIRO
YAMAGUCHI TAKAAKI

(54) THREE-DIMENSIONAL SEMICONDUCTOR ELEMENT, INK TANK HAVING THE SAME ARRANGED THEREIN, AND INK-JET RECORDING DEVICE ONTO WHICH THE INK TANK IS MOUNTED

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a three-dimensional semiconductor element to be used for detecting the type of ink housed in an ink tank, etc.
SOLUTION: The three-dimensional semiconductor element 31, arranged in the ink tank (not shown) has an energy-converting means 34 for transducing an electromotive force 32, which is the energy from the outside A, into electric power 33, which is a different type of energy and a light emitting means 35 for emitting light by the electric power 33 created by the energy transducing means 34.



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CLAIMS

[Claim(s)]

[Claim 1] The solid form semiconductor device which has an energy conversion means to transform the energy from the outside into the energy of a different class, and a luminescence means to emit light with the energy changed with this energy conversion means.

[Claim 2] Said luminescence means is a solid form semiconductor device according to claim 1 constituted so that light may be emitted in the light containing the wavelength of the range of 300-700nm.

[Claim 3] Said luminescence means is a solid form semiconductor device according to claim 1 constituted so that light may be emitted in the light whose wavelength is 500nm.

[Claim 4] The external energy which said energy conversion means changes is a solid form semiconductor device given in any 1 term of claims 1-3 supplied by non-contact.

[Claim 5] The energy changed with said energy conversion means is a solid form semiconductor device given in any 1 term of claims 1-4 which is power.

[Claim 6] The ink tank by which at least one solid form semiconductor device of a publication was allotted to any 1 term of claims 1-5.

[Claim 7] An ink jet recording device equipped with a light-receiving means to receive the light which penetrated the ink which emitted light with the luminescence means of said solid form semiconductor device which is the ink jet recording device with which an ink tank according to claim 6 is carried, and was allotted in said ink tank, and was held in said ink tank.

[Claim 8] The ink jet recording device according to claim 7 which is constituted so that a position may be equipped with each of two or more of said ink tanks according to the class of ink held in said each ink tank, and equips the user with the means which emits warning when it is detected that the unsuitable location was equipped with said ink tank by said light-receiving means which received said light.

[Claim 9] It is constituted so that a position may be equipped with each of two or more of said ink tanks according to the class of ink held in said each ink tank. When it is detected that the unsuitable location was equipped with said ink tank by said light-receiving means which received said light An ink jet recording device [equipped with the control means which controls the recording head to which ink is supplied according to the class of this ink from the this ink tank with which it was equipped] according to claim 7.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the solid form semiconductor device which will emit light if energy is supplied from the exterior.

[0002] Moreover, this invention relates to the ink jet recording device with which the ink tank by which the above-mentioned solid form semiconductor device was allotted, and this ink tank are carried removable and which is used for a facsimile printer, a copying machine, etc.

[0003]

[Description of the Prior Art] Making ink inject conventionally from two or more injection nozzles prepared in the recording head, in the ink jet recording device it was made to print an image in a form by the dot pattern, he forms the ink tank which held the ink for record, and is trying to supply the ink of the ink tank to a recording head through an ink supply way by moving the carriage which carried the recording head in the printing direction. Then, many things are proposed also about practical use being presented with the ink residue detection equipment which detected the residue of the ink of the ink tank.

[0004] For example, according to JP,6-143607,A, the floatage object 703 with which two electrodes (one pair) 702 were arranged by the inside by the side of the bottom of the ink tank 701 with which non-conductive ink is filled as shown in drawing 12 , and the electrode 702 and the electrode 704 in an opposite location were arranged into the ink in the ink tank 701 is floating. If two electrodes 702 are connected to the detection section (un-illustrating) which detects the switch-on of two electrodes, respectively and the switch-on of two electrodes is detected, the ink residue error which shows that there is no ink in the ink tank 701 is emitted, and stopping actuation of the ink jet recording head 705 is indicated.

[0005] Moreover, as shown in drawing 13 , while the lower part is formed in the shape of a funnel toward a base according to ****** No. 2947245, two conductors 801,802 are formed in a base and the ink cartridge 805 for ink jet printers of a configuration of that the metal ball 804 with specific gravity smaller than ink 803 is installed in the interior is indicated. With such a configuration, if ink 803 is consumed and it decreases, the oil level of ink 803 will fall. In connection with it, the location of the metal ball 804 which is floating on the front face of ink 803 falls. If the oil level of ink 803 falls to the location of the base of an ink cartridge housing, the metal ball 804 will touch two conductors 801,802. Then, since a conductor 801,802 flows, a current flows in the meantime. If the conduction is detected, ink and a condition are detectable. If ink and a condition are detected, the information which shows ink and a condition will be told to a user.

[0006]

[Problem(s) to be Solved by the Invention] Although the configuration which detects the ink residue in an ink tank which is represented in an official report conventionally which was mentioned above is known, it is necessary to arrange the electrode for detection in an ink tank with such a configuration. Moreover, in order to detect an ink residue by inter-electrode switch-on, constraint will arise in the ink to be used -- a metal ion cannot be used for an ink component. Moreover, with the above-mentioned configuration, only an ink residue can be detected and information in a tank, such as a class of ink held in the ink tank, cannot be known.

[0007] Furthermore, in the ink jet recording device printed using two or more ink, in order to use ink without futility, a position may be equipped with two or more ink tanks for every color. In order to prevent that a user equips an unsuitable location with an ink tank in such an ink jet recording device, the ink tank of each color is made into a different configuration, and it is common to prevent from equipping in an unsuitable location. However, only the number of the colors of ink had the case where it led to the cost rise of an ink tank, by changing the configuration of an ink tank. Therefore, an ink tank which can prevent incorrect wearing is desired, the configuration of an ink tank being the same.

[0008] In developing the above ink tanks, this invention persons paid their attention to the ball semiconductor of ball Semiconductor of forming a semiconductor integrated circuit on the spherical surface with a diameter of 1mm of a silicon ball. Since this ball semiconductor was a globular form, when holding this in the ink tank, it was expected that the exchange of the information on the exterior can be performed very efficiently compared with a plan type. However, when the thing with such a function was investigated, the development with the above-mentioned function of the component

itself is needed only by the technique which connects ball semiconductors by electric wiring like USP No. 5877943 existing. Moreover, in order for this component to be a thing applicable effective in an ink tank, the technical problem which must be cleared also occurred. One of the technical problems is supply of the power for starting the component held in the tank. Since the connecting means of a power source and a component will be needed, the manufacturing cost of a tank will increase and a tank cartridge will become expensive even when a tank becomes large-sized or it equips the tank exterior with a power source if the power source for starting of a component is given to an ink tank, a component is started by non-contact from the exterior, and if it is ****, there is nothing. [0009] as further technical problem, it is distance **** more fixed than the liquid ink side and oil level of an ink tank -- it is floating in ink. For example, although it is desirable to locate a component in a liquid ink side for supervising fluctuation of the amount of negative pressure accompanying the ink consumption in an ink tank with time, since a component consists of silicon with larger specific gravity than water, it is difficult for it to make ink float.

[0010] The purpose of this invention is to offer the solid form semiconductor device used for detection of the class of ink held in the ink tank etc.

[0011] Moreover, the further purpose of this invention is to offer the ink jet recording device with which the ink tank by which the above-mentioned component was allotted, and this ink tank are carried.

[0012]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the solid form semiconductor device of this invention has an energy conversion means to transform the energy from the outside into the energy of a different class, and a luminescence means to emit light with the energy changed with this energy conversion means.

[0013] In the solid form semiconductor device of this invention constituted as mentioned above, supply of the energy from the outside transforms the external energy into the energy which differs from it with an energy conversion means. The luminescence means of a solid form semiconductor device emits light with the energy which it was changed with the energy conversion means and generated. Compared with the case where an energy conversion means and a luminescence means are made by the semiconductor device of a solid form, and the semiconductor device of a monotonous form is used since the energy transfer is possible in three dimension, there are also few limits of the direction of an energy transfer. For this reason, supply and the light emission of the energy from the outside can be performed efficiently.

[0014] Generally, since absorption-of-light spectrums differ for every ink color, the ink used in an ink jet recording device etc. can distinguish the color types of the ink which the light penetrated by detecting the reinforcement in wavelength with the light which penetrated ink. Therefore, it becomes possible to distinguish the class of the ink by making the light which emitted light by the solid form semiconductor device penetrate in ink, and detecting the reinforcement in wavelength with the transmitted light.

[0015] As for said luminescence means, it is desirable to be constituted so that light may be emitted in the light containing the wavelength of the range of 300-700nm. When the colors of the ink used are yellow, MAZENDA, cyanogen, and black, the peak of these absorptivities is distributing in this wavelength range. Therefore, it becomes possible by using the light of the wavelength range of this range to distinguish any of the above the colors of the ink which light penetrated are by detecting which wavelength was absorbed most.

[0016] Moreover, said luminescence means may be constituted so that light may be emitted in the light whose wavelength is 500nm. Since the absorptivities in the wavelength of 500nm differ clearly mutually when the colors of the ink used are yellow, MAZENDA, cyanogen, and black, it becomes possible to distinguish any of the above the colors of the ink which light penetrated are because the reinforcement of the transmitted light to the radiation luminous intensity in a luminescence means detects comparatively (translucent rate).

[0017] Furthermore, by considering as the configuration supplied by non-contact, the external energy which said energy conversion means changes does not need to give the energy source for starting of a component to an ink tank, or does not need to connect wiring for energy supply to a component, and giving direct wiring with the exterior can use it for a difficult part.

[0018] Furthermore, the energy changed with said energy conversion means is good also as a configuration which is power. According to this configuration, by forming so that the conductor coil of an oscillator circuit may be twisted around the outside surface of a solid form semiconductor device as an external energy conversion means, a conductor coil is made to generate power by electromagnetic induction between external resonance circuits, and power can be supplied to a component by non-contact.

[0019] Moreover, as for the ink tank of this invention, at least one solid form semiconductor device of above-mentioned this invention is allotted.

[0020] Moreover, the ink jet recording apparatus of this invention is an ink jet recording apparatus with which the ink tank of above-mentioned this invention is carried, emitted light with the luminescence means of said solid form semiconductor device

allotted in said ink tank, and is equipped with a light-receiving means to receive the light which penetrated the ink held in said ink tank.

[0021] Furthermore, it is constituted so that a position may be equipped with each of two or more of said ink tanks according to the class of ink held in said each ink tank, and when it is detected that the unsuitable location was equipped with said ink tank by said light-receiving means which received said light, it is good also as a configuration which equips the user with the means which emits warning. According to this, a user can reequip a suitable location with an ink tank.

[0022] Or it is constituted so that a position may be equipped with each of two or more of said ink tanks according to the class of ink held in said each ink tank. When it is detected that the unsuitable location was equipped with said ink tank by said light-receiving means which received said light, it is good also as a configuration equipped with the control means which controls the recording head to which ink is supplied according to the class of this ink from the ink tank with which it was this equipped. Since according to this configuration suitable image recording is automatically performed even when a user equips the location which made a mistake in the ink tank, it becomes unnecessary for a user to care about the stowed position of an ink tank.

[0023]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. Especially the operation gestalt in the case of having arranged the component in an ink tank is explained to a detail. In addition, the same effectiveness is acquired, even if this component is not used only for an ink tank and it allots and uses it into other objects.

[0024] Drawing 1 is a block block diagram showing the internal configuration of the solid form semiconductor device by 1 operation gestalt of this invention, and the exchange with the exterior. The solid form semiconductor device 31 of the gestalt shown in this drawing is equipped with an energy conversion means 34 to change into power 33 the electromotive force 32 which is the external energy supplied by non-contact toward the component 31 from Exterior A, and a luminescence means 35 to make light emit light using the power which obtained with the energy conversion means 34, and is allotted into the ink in an ink tank. The luminescence means 35 is constituted by the photodiode etc.

[0025] In addition, as electromotive force supplied in order to operate a component, electromagnetic induction, heat, light, a radiation, etc. are applicable. Moreover, as for the energy conversion means 34 and the luminescence means 35, it is desirable to be

formed a front face or near a front face a component.

[0026] With such a gestalt, if electromotive force 32 is given toward a component 31 from Exterior A, the energy conversion means 34 will change electromotive force 32 into power 33, and the luminescence means 35 will emit light 36 using the power 33. As for the light 36 emitted from the luminescence means 35, the reinforcement is detected by Exterior B.

[0027] In addition, the "solid form" of the "solid form semiconductor device" in this specification includes all various solid forms, such as the triangle pole, a ball, a hemisphere, the square pole, a spheroid, and 1 shaft body of revolution.

[0028] Moreover, what is necessary is just to form a means to supply electromotive force to a component as external energy in a recovery position, a return position or carriage, a recording head, etc. as the supply approach of external energy, when used for an ink jet recording device. It will be used for inspection etc., if the condition inside an ink tank can be known, for example, it uses in works or a dealer besides this, even if there will be no ink jet recording device, if the equipment which has a means to supply electromotive force is used (QA).

[0029] Next, the example of a configuration of the ink tank which can apply the solid form semiconductor device of the gestalt of operation mentioned above is shown in drawing 2 - drawing 4 . The ink tank 501 shown in drawing 2 arranges the flexible ink bag 502 which contained ink in a case 503, closes bag mouth 502a with the rubber stopper 504 fixed to the case 503, is thrusting the hollow needle 505 for ink derivation into a rubber stopper 504, and making it open for free passage in a bag, and performs ink supply to a non-illustrated ink jet head. The solid form semiconductor device 506 of this invention can be arranged in the ink bag 502 of such an ink tank 501.

[0030] Moreover, the ink tank 511 shown in drawing 3 attaches the ink jet head 515 which turns ink to the detail paper S and performs discharge record to the ink feed hopper 514 of the case 512 which held ink 513. The solid form semiconductor device 516 of this invention can be arranged in the ink 513 in such a tank 511.

[0031] Moreover, the ink tank 521 shown in drawing 4 is equipped with the 1st room in the full sealing condition of holding ink 522, the 2nd room of the atmospheric-air free passage condition which contains the negative pressure generating member 523, and the free passage way 524 that makes the 1st room and the 2nd room open for free passage at the tank bottom. If ink is consumed from the ink feed hopper 525 by the side of the 2nd room, from the 2nd room side, it will replace that atmospheric air goes into the 1st room, and the ink 522 of the 1st room will be drawn by the 2nd room. Also in the ink 522 in such a tank 521, the solid form semiconductor device 526 of this invention

can be arranged.

[0032] Next, a schematic diagram shows the example of a configuration of the ink jet recording device carrying the ink tank equipped with the solid form semiconductor device of this invention to drawing 5 . The head cartlidge 601 carried in the ink jet recording apparatus 600 shown in drawing 5 has the liquid discharge head which carries out the regurgitation of the ink for printing record, and an ink tank as shown in drawing 2 holding the liquid supplied to the liquid discharge head - drawing 4 . Moreover, a means (un-illustrating) to receive the light emitted from a means 622 to supply the electromotive force which is external energy to the solid form semiconductor device allotted in this ink tank, or said component is installed in the recording device 600.

[0033] The head cartlidge 601 is carried on the carriage 607 engaged to the spiral slot 606 of a leading screw 605 which is interlocked with the forward inverse rotation of a drive motor 602, and is rotated through the driving force transfer gears 603 and 604, as shown in drawing 5 . Along with a guide 608 in carriage 607, both-way migration of the head cartlidge 601 is carried out in the direction of arrow heads a and b by the power of a drive motor 602. The ink jet recording apparatus 600 is equipped with a recorded-media conveyance means (un-illustrating) to convey the print form P as recorded media which receive liquids, such as ink breathed out from the head cartlidge 601. The paper presser-foot plate 610 of the print form P which has a platen 609 top conveyed presses the print form P to a platen 609 covering the migration direction of carriage 607 with the recorded-media conveyance means.

[0034] Photo couplers 611 and 612 are arranged near the end of a leading screw 605. Photo couplers 611 and 612 are the home-position detection means for checking existence [in the field of photo couplers 611 and 612 of lever 607a of carriage 607], and performing a switch of the hand of cut of a drive motor 602 etc. Near the end of a platen 609, it has the supporter material 613 which supports the wrap cap member 614 in the front face with the delivery of a head cartlidge 601. Moreover, it has an ink suction means 615 to attract the ink with which air ejecting etc. was carried out from the head cartlidge 601, and the interior of the cap member 614 was covered. Suction recovery of a head cartlidge 601 is performed by this ink suction means 615 through opening of the cap member 614.

[0035] The ink jet recording device 600 is equipped with the body base material 619. The migration member 618 is supported by this body base material 619 movable in the right-angled direction to the cross direction, i.e., the migration direction of carriage 607. The cleaning blade 617 is attached in the migration member 618. A cleaning blade 617

may be a well-known cleaning blade of not only this gestalt but other gestalten. Furthermore, it has the lever 620 for starting suction in the suction recovery operation by the ink suction means 615, and it moves with migration of the cam 621 which engages with carriage 607, and, as for a lever 620, migration control of the driving force from a drive motor 602 is carried out with a means of communication with a well-known clutch switch etc. The ink jet record control section which gives a signal to the heating element prepared in the head cartlidge 601, or manages drive control of each device mentioned above is prepared in the body side of a recording device, and is not shown by drawing 5 .

[0036] In the ink jet recording device 600 which has the configuration mentioned above, a head cartlidge 601 carries out both-way migration covering full [of the print form P] to the print form P which has a platen 609 top conveyed by the aforementioned recorded-media conveyance means. If a driving signal is supplied to a head cartlidge 601 from a driving signal supply means by which it does not illustrate at the time of this migration, according to this signal, ink (record liquid) will be breathed out from the liquid discharge-head section to recorded media, and record will be performed.

[0037] Next, the desirable operation gestalt in the case of arranging the solid form semiconductor device of this invention in an ink tank is explained in more detail.

[0038] First, an information acquisition means applicable to the solid form semiconductor device of this invention is mentioned as an example. When the solid form semiconductor device arranged in an ink tank is made by spherical silicon, as an information acquisition means explained with the gestalt of the above-mentioned operation (1) The sensor which makes SiO2 film and the SiN film as an ion sensing membrane, and detects pH of ink, (2) The pressure sensor which has diaphram structure and detects the pressure variation in a tank, (3) Light is changed into heat energy, the photodiode which has a pyroelectric effect is made, a current location is detected, and the sensor which detects an ink residue, the sensor which detects ink existence with the moisture content in a tank using the electric conduction effectiveness of (4) ingredients can be mentioned.

[0039] Next, the example of an energy generation means applicable to the solid form semiconductor device of this invention is given. Drawing 6 is drawing for explaining the power generating principle of the energy generation means which is the component of the solid form semiconductor device of this invention.

[0040] In drawing 6 , if the coil La of the external resonance circuit 101 is adjoined, the conductor coil L of an oscillator circuit 102 is placed and Current Ia is passed in Coil La through the external resonance circuit 101, the magnetic flux B which pierces through

the coil L of an oscillator circuit 102 according to Current Ia will arise. Here, since the magnetic flux B which pierces through Coil L will change if Current Ia is changed, induced electromotive force V arises in Coil L. Therefore, the power which operates a component can be generated in the induced electromotive force by the electromagnetic induction from the outside by making the oscillator circuit 102 as an energy generation means to spherical silicon, and arranging the external resonance circuit 101 for example, in the ink jet recording device of the component exterior so that the conductor coil L of the oscillator circuit 102 by the side of a component and the coil La of the resonance circuit 101 of the component exterior may adjoin.

[0041] Moreover, since the magnetic flux B which pierces through the coil L of number-of-turns N of an oscillator circuit 102 made as an energy generation means to spherical silicon is proportional to number-of-turns Na of the coil La of the external resonance circuit 101, and the product of Current Ia, it sets a proportionality constant to k, and it is [0042].

[Equation 1]

B=k*Na*Ia The electromotive force V produced in the ** coil L is [0043].

[Equation 2]

V=-N{dB/dt}

=-kNaN{dIa/dt}

= -M {dIa/dt} [** -- if magnetic flux B sets the permeability of the core of a coil to mua and it sets a field to H here -- 0044]

[Equation 3]

B=mu aH (z)

= It becomes {muaNaIara2/2(ra2+z2) 3/2 **. Here, z shows the distance of the coil of an external resonance circuit, and the coil made to spherical silicon.

[0045] ** The mutual inductance of a formula : M is [0046].

[Equation 4]

M= {mu N/mu aIa} integralsB-dS It becomes ={mumuara2NaNS/2microo(ra2+z2) 3 / 2} **. Here, muo is space permeability.

[0047] And impedance:Z of the dispatch circuit made to spherical silicon is [0048].

[Equation 5]

Z(omega) =R+j {omegaL- (1-/omegaC)} It is expressed **, and impedance:Za of an external resonance circuit is [0049].

[Equation 6]

It becomes Za(omega) = Ra+jomegaLa-{omega2M2/Z(omega)} **. Here, J expresses magnetization. And an impedance when this external resonance circuit resonates

(current value: when Ia becomes max): Zo is [0050].

[Equation 7]

Becoming Zo(omegao) = Ra+jLaomegao·(omegao2M2/R) **, delay phi of the phase of this resonance circuit is [0051].

[Equation 8]

It becomes tanphi={jLaomegao·(omegao2M2/R)}/R **.

[0052] And resonance frequency of this external resonance circuit: fo is [0053].

[Equation 9]

It asks by fo=1/2pi(LC) 1/2 **.

[0054] If the impedance of the oscillator circuit 102 made to spherical silicon carries out adjustable from the above relation according to change of the ink in an ink tank, the frequency of the external resonance circuit 101 will be changed and change of the above-mentioned ink will appear in the amplitude and phase contrast of an impedance of the external resonance circuit 101. Furthermore, the ink residue (namely, change of z) is also contained in this phase contrast and amplitude.

[0055] For example, since the output (impedance) from the oscillator circuit 102 made to spherical silicon changes according to a surrounding environmental variation by carrying out adjustable [of the resonance frequency of the external resonance circuit 101], the existence and the ink residue of ink are detectable by detecting frequency dependent [this].

[0056] Therefore, only as an energy generation means to generate power, the oscillator circuit made to spherical silicon is the relation of the oscillator circuit and external resonance circuit, and can be used also as a part of means to detect change of the ink in a tank.

[0057] Drawing 7 is the outline block diagram of the ink tank which used the solid-form semiconductor device of this invention. It is floating near the oil level of the raw ink 522 in the ink tank 521, and the solid form semiconductor device 526 shown in this drawing is made to carry out induction of the electromotive force by electromagnetic induction by the external resonance circuit besides the ink tank 521 (un-illustrating), it is that the photodiode near arranged in the front face of the solid form semiconductor device 526 drives, and emits light. The light penetrates ink 522 and is received with the photosensor 550 of the exterior of the ink tank 521.

[0058] The extinction wavelength of typical ink (yellow, a Magenta, cyanogen, black) is shown in drawing 8 . In a 300-700nm wavelength range, the peak of an absorptivity is distributing the ink of each color of yellow, MAZENDA, cyanogen, and black so that drawing 8 may show. For about 390nm and MAZENDA, about 500nm and black are

[yellow / about 590nm and the cyanogen of the peak of the absorptivity of the ink of each color] about 620nm. Therefore, the light containing the wavelength of the range of 300-700nm can be made to be able to emit light from a solid form semiconductor device, light can be received with the photosensor 550 (refer to drawing 7) which is made to penetrate the light in ink and is out of an ink tank, and the color of the ink which light penetrated can distinguish any of the above they are by detecting which wavelength was absorbed most.

[0059] Moreover, the ink of each color of yellow, MAZENDA, cyanogen, and black differs in an absorptivity clearly mutually in the wavelength of 500nm so that drawing 8 may show. For black, yellow is [MAZENDA / the cyanogen of the absorptivity of the ink of each color in the wavelength of 500nm] about 5% about 20% about 50% about 80%. Therefore, the color of the ink which light penetrated can distinguish any of the above they are because the reinforcement of the ink transmitted light to the luminous intensity which emitted light by the solid form semiconductor device detects comparatively (translucent rate) about 500nm wavelength light.

[0060] In addition, it is possible in above any case, to allot one kind of solid form semiconductor device in a different ink tank, respectively, and to distinguish two or more ink kinds.

[0061] Moreover, in the ink jet recording device constituted so that a position may be equipped with each of two or more ink tanks according to the class of ink held in each ink tank, when it is detected that the unsuitable location was equipped with the ink tank by the photosensor 550 which received the light which penetrated the ink in an ink tank, the user may be equipped with the means which emits warning. As a warning means in this case, singing means, such as luminescence means, such as a lamp, and a buzzer, etc. can be used. By warning by the warning means, a user gets to know having equipped the location which mistook the ink tank, and can reequip an original location with the ink tank.

[0062] Or in such an ink jet recording device, when it is detected that the unsuitable location was equipped with the ink tank by the photosensor light which received the light which penetrated the ink in an ink tank, you may have the control means which controls the recording head to which ink is supplied according to the class of the ink from the ink tank with which it was equipped. Since according to this suitable image recording is automatically performed even when a user equips the location which made a mistake in the ink tank, it becomes unnecessary for a user to care about the stowed position of an ink tank.

[0063] Next, the manufacture approach of the solid form semiconductor device of this

example is explained. Drawing 9 is process drawing for explaining an example of the manufacture approach of the solid form semiconductor device of this invention, and shows each process in the cross section passing through the core of spherical silicon. Moreover, the center of gravity of spherical silicon is created so that it may become below a core, and the upper part inside a spherical-surface object is made into a cavity, and the manufacture approach of holding the cavernous section in the airtight condition is further mentioned as an example here.

[0064] In order to form opening 203 in some SiO2 film as shown in drawing 9 (c) after forming SiO2 film 202 of thermal oxidation on [all] a front face to the spherical silicon shown in drawing 9 (a), as shown in drawing 9 (b), patterning is carried out using a photolithography process.

[0065] And as shown in drawing 9 (d), by the anisotropic etching using the KOH solution which leads opening 203, only a upside silicon part removes and the cavernous section 204 is formed. then, it is shown in drawing 9 (e) -- as -- LPCVD -- the SiN film 205 is formed in the inside-and-outside front face of a solid form component using law.

[0066] Furthermore, as shown in drawing 9 (f), the Cu film 206 is formed on all the front faces of a solid form component using a metal CVD method. And as shown in drawing 9 (g), patterning of the Cu film 206 is carried out using a well-known photolithography process, and the conductor coil L of number-of-turns N which is a part of oscillator circuit is formed. Then, the solid form component in which the conductor coil L was formed is taken out from vacuum devices into atmospheric air, the closure members 207, such as resin and a plug, close the upside opening 203, and the cavernous section 204 inside a spherical-surface object is changed into a sealing condition. Thus, if it manufactures, buoyancy can be given to the solid form semiconductor device itself which consists of silicon even if it does not have a means to generate buoyancy using power like the gestalt of the 3rd operation.

[0067] Moreover, before manufacturing the solid form semiconductor device of such a suspension mold, drive circuit elements other than the coil L formed in spherical silicon use N-MOS circuit component. The typical sectional view cut so that it might travel through N-MOS circuit component to drawing 10 is shown.

[0068] According to drawing 10 , by the impurity installation and diffusion of an ion plantation etc. using a general Mos process, P-Mos450 is constituted by the N type well field 402, and N-Mos451 is constituted by the Si substrate 401 of P conductor to the P type well field 403. P-Mos450 and N-Mos451 consist of the source fields 405 and drain field 406 grades which carried out impurity installation of the gate wiring 415 by poly-Si deposited on 4000A or more thickness of 5000A or less with the CVD method

through gate dielectric film 408 of 100A of thickness numbers, respectively and N type, or P type, and C-Mos logic is constituted by these P-Mos450 and N-Mos451.

[0069] The N-Mos transistor 301 for a component drive is too constituted from a drain field 411 on the P type well substrate 402, a source field 412, and gate wiring 413 grade by processes, such as impurity installation and diffusion.

[0070] Here, if the N-Mos transistor 301 is used as a component drive driver, the distance L between the drain gates which constitute one transistor will be set to about 10 micrometers at the minimum value. Although one of the 10-micrometer items of the is the width of face of the source and the contact 417 of a drain and the amount of those width of face is 2x2 micrometers, since the one half serves as combination with the next transistor, it is 2 micrometers of 1/the 2 in practice. Everything but the items is 4 micrometers for the width of face of 2x2 micrometers [for the distance of contact 417 and the gate 413] 4 micrometers, and the gate 413, and is set to a total of 10 micrometers.

[0071] Between each component, the oxide-film isolation region 453 is formed of with a 5000A or more thickness [thickness 10000A or less] field oxidation, and it is detached by the component. This field oxide acts as an accumulation layer 414 of an eye further.

[0072] After each component is formed, and an interlayer insulation film 416 accumulates on the thickness which is about 7000A by PSG by the CVD method, the BPSG film, etc. and is made it by heat treatment in flattening processing etc., wiring is performed through the contact hole by the aluminum electrode 417 used as the 1st wiring layer. Then, the interlayer insulation films 418, such as SiO2 film by the plasma-CVD method, were deposited on 10000A or more thickness of 15000A or less, and the through hole was formed further.

[0073] This N-Mos circuit is formed before forming the solid form semiconductor device of a suspension mold like drawing 9 . And connection with the oscillator circuit as an energy generation means of this invention, the sensor section as an information acquisition means, etc. is made through the above-mentioned through hole.

[0074] Moreover, the magnetic flux (field) stabilized in any conditions by the ink tank which allotted the solid form semiconductor device of the suspension mold of this example between the oscillator circuit made from the above processes by spherical silicon and the external resonance circuit shown in drawing 6 needs to be working. However, when it floats in liquids, such as ink, an oil level may vibrate by extraneous vibration. Even in such a case, in order to hold the condition of having been stabilized in the liquid, in this example, the center of gravity of the solid form semiconductor device of a suspension mold is determined.

[0075] When the ball form semiconductor device 210 of this example is made to float in a liquid as drawing 11 shows, in order to be in the condition of balance, it is required like drawing 11 (a) to realize relation called coincidence in the line of action of the weight W (2) buoyancy of a (1) buoyancy F= body and the line of action (line passing through a center of gravity G) of weight.

[0076] And when a liquid vibrates according to external force and the solid form semiconductor device 210 inclines for a while from the condition of balance like drawing 11 (b), center of buoyancy moves and it becomes a couple by buoyancy and weight.

[0077] Here, the distance h of a metacenter, a call and a metacenter, and a center of gravity is called the height of a metacenter in the intersection of the line of action (alternate long and short dash line in drawing 11 (b)) of the weight when being in the condition of balance, and the line of action (continuous line in drawing 11 (b)) of the buoyancy when inclining.

[0078] Like this example, since the metacenter of the solid form semiconductor device 210 is in a location higher than a center of gravity, a couple (stability) acts on the sense which it is going to return to the location of balance of origin. This stability: T is [0079].

[Equation 10]

$$T = Wh\sin\theta = Fh\sin\theta$$
$$= \rho g V h \sin\theta \quad (>0)$$

It is come out and expressed. Here, V and specific weight of the solid form semiconductor device 210 are set to rhog for the volume of the liquid which the solid form semiconductor device 210 eliminated.

[0080] So, in order to just carry out this stability, being set to h> 0 is a necessary and sufficient condition.

[0081] From drawing 11 (b) [to 0082 [and]]

[Equation 11]

$$h = (I/V) - \overline{CG}$$

It becomes. Here, I is the moment of inertia of the circumference of O shaft. Therefore,

[0083]

[Equation 12]

$$(I/V) > \overline{CG}$$

The ball form semiconductor device 210 stabilizes and floats in ink, and becoming becomes a requirement for supplying dielectric electromotive force from an external

resonance circuit.

[0084] Although electromagnetic induction with a coil was used in the above solid form semiconductor devices of an example as external energy which supplies the power which starts a component , when light may be use in addition to this and it changes the light and darkness of this light into an electrical signal , power can be generate according to the photoconductive effect using the ingredient (for example , photoconductor) from which resistance changes with the exposures of light . As photoconductor, a binary alloy/ternary alloys, such as CdS, InSb, and Hg0.8Cd0.2Te, GaAs, Si, Va-Si, etc. are used. Furthermore, when using heat as electromotive force, power can be generated according to the quantum effectiveness from the radiant energy of the matter.

[0085] Moreover, the solid form semiconductor device of this example supplies the ink held in the ink tank with which it was equipped removable to an ink jet recording head, detects ink information about the ink jet recording device printed in a record form by the ink droplet injected from the recording head, and is preferably applied to controlling a recording device by the optimal approach.

[0086] In addition, although sheathing of an ink jet recording apparatus was not illustrated in this example, since a user can be seen in the light of a tank when an ink tank also uses a translucent thing using what the condition of inside, such as translucence, can be regarded as in covering of sheathing, "a thing [a thing] to exchange tanks, for example" is intelligible, and can give a user the volition which is going to exchange tanks. (Although the carbon button of the body of equipment shines conventionally, since it serves as some display functions, it is unclear for a user in wanting whether to tell what is light.)

[0087]

[Effect of the Invention] The class of ink can be distinguished by making the light emitted from the solid form semiconductor device since this invention had an energy conversion means to by_which a solid form semiconductor device transform the energy from the outside into the energy of a different class , and a luminescence means emitted light with the energy changed with the energy conversion means penetrate in ink , as explained above , and detecting the reinforcement in wavelength with the transmitted light .

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is a block block diagram showing the internal configuration of the solid form semiconductor device by 1 operation gestalt of this invention, and the exchange with the exterior.

[Drawing 2] It is drawing showing the example of a configuration of the ink tank which can apply the solid form semiconductor device of this invention.

[Drawing 3] It is drawing showing the example of a configuration of the ink tank which can apply the solid form semiconductor device of this invention.

[Drawing 4] It is drawing showing the example of a configuration of the ink tank which can apply the solid form semiconductor device of this invention.

[Drawing 5] It is the outline block diagram of the ink jet recording device carrying the ink tank equipped with the solid form semiconductor device of this invention.

[Drawing 6] It is drawing for explaining the power generating principle of the energy generation means which is the component of the solid form semiconductor device of this invention.

[Drawing 7] It is the outline block diagram of the ink tank using the solid form semiconductor device of this invention.

[Drawing 8] It is the graph which shows the extinction wavelength of typical ink (yellow, a Magenta, cyanogen, black).

[Drawing 9] It is process drawing for explaining an example of the manufacture approach of the solid form semiconductor device of this invention.

[Drawing 10] It is the typical sectional view cut so that it might travel through N-MOS circuit component used for the solid form semiconductor device of this invention.

[Drawing 11] It is drawing for explaining the conditions for holding the condition that the solid form semiconductor device manufactured by the approach shown by drawing 9 was stabilized in the liquid.

[Drawing 12] It is drawing showing the ink residue detection equipment of a publication in JP,6-143607,A.

[Drawing 13] It is drawing showing [****** / No. 2947245] the ink residue detection equipment of a publication.

[Description of Notations]

31,506,516,526 Solid form semiconductor device

32 Electromotive Force

33 Power

34 Energy Conversion Means

35 Luminescence Means

36 Light

101 External Resonance Circuit

102 Oscillator Circuit

201 Spherical Silicon

202 SiO2 Film

203 Opening

204 Cavernous Section

205 SiN Film

206 Cu Film

207 Closure Member

210 Ball Form Semiconductor Device

501,511,521 Ink tank

502 Ink Bag

502a Bag mouth

503,512 Case

504 Rubber Stopper

505 Hollow Needle

513,522 Ink

514,525 Ink feed hopper

515 Ink Jet Head

523 Negative Pressure Generating Member

524 Free Passage Way

[Translation done.]